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Original Communication

Changes in genital injury patterns over time in women after consensual intercourse ☆

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Abstract

To date, there are no studies in the literature addressing whether or not microscopic genital injuries change over time or change in appearance during the 72 h time period following intercourse. In this study, women ($n = 35$) had two evidentiary type pelvic examinations to document injuries after consensual intercourse. At Time 1 (within 48 h of consensual intercourse) a: larger total surface area of injury ($p = 0.02$); larger surface area of injury to the posterior fourchette ($p = 0.02$); larger surface area of abrasions ($p = 0.04$); and larger surface area of redness ($p = 0.04$) were found compared to Time 2 (24 h after Time 1). Since this research is exploratory, larger studies are needed to explore the differences in genital injuries based on the time of examination and in women after non-consensual intercourse. Published by Elsevier Ltd and FFLM.

Keywords: Genital injury; Colposcopy; Consensual intercourse; Sexual assault

1. Introduction

Women are frequently seen in the emergency room for medical care and evidence collection within 72 h after a sexual assault. In addition to collecting clothing, swabs for possible DNA, and trace evidence, an important part of evidence collection includes documentation of genital and other physical injuries. It has been documented that microscopic injuries to the genital area tend to heal quickly, usually within 72 h.[1,2] The injuries most commonly seen in sexual assault victims are usually confined to the epidermal and superficial dermal layers of the genitalia, which tend to heal by regeneration frequently within 4 days without scarring.[3] While the prevalence of genital injury is higher in rape,[2] injuries are present after consensual intercourse and the patterns of injuries have yet to be definitively differentiated.[1]

Characteristically, the appearance of the injuries differs as healing occurs from time of injury until the area has healed. The current literature on changes of injuries includes studies on dating of bruises in children;[4,5] stages of healing or non-healing in larger wounds such as surgical incisions;[6] or stages of chronic pressure ulcers.[3,7,8] To date, there are no studies in the literature addressing whether or not microscopic genital injuries change over time or in appearance over the time period following a sexual assault. Because evidence is typically collected up to 72 h following an assault, it is important to determine differences over time. Other factors that have not been investigated include pain and roughness at the time of intercourse,[1] and the average weekly frequency of sexual intercourse.

Therefore, the purpose of this study was to determine how injury patterns change between an initial pelvic examination (within 48 h of intercourse) and a second exam 24 h later following consensual intercourse. The goal was to assess injury patterns over time on the extent of injuries in women after consensual intercourse to better understand genital injury findings in sexually assaulted women.

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2. Review of the literature

2.1. Genital injuries after consensual intercourse

In reviewing the research literature after consensual intercourse, six studies were identified.[1,2,9–12] All six of the studies investigated genital injuries after consensual intercourse either as part of larger study to investigate differences between consensual and non-consensual intercourse or to explore the efficacy of injury detection tools used following sexual assaults injury rates ranged from 5 to 61%.[10]

Methodological differences made comparisons difficult. Studies varied based on time from intercourse to examination, age ranges, tools used to identify injuries, and how participants were recruited. Time from intercourse to examination ranged from 0–6 h;[10] 0–24 h[1,2] and greater than 24 h.[9–12] The group seen within 6 h of intercourse[10] had the highest injury rate (61%). By increasing time from intercourse to examination to 24 h, two studies reported injury rates of 11%[10] and 30%.[1] As the time increased to include participants outside of the first 24 h, the genital injury rate decreased to a low of 5%[9] and a high of 28%.[11] Six percent of participants who abstained from intercourse for 72 h also had genital injuries.[10]

The age of study participants varied from study to study. Of the five studies, three of the studies included adults between the ages of 18 and 40,[1,10,12] one study did not state exact age range, but referred to the participants as "women",[9] and one study saw both adolescents and adults (age range 13–48).[2] injury rates varied from 5%[9] to 61%.[10] Just as time and age differences affected injury rates, so did the rate of injury detection based on the types of tools used to detect injury. The tools used were direct visualization, tissue staining dyes, colposcopy, and the combination of dye with colposcopy. Two studies that used only tissue staining dye found injury rates from 5%[9] to 33%. [11] Both studies noted that participants with dye uptake complained of pain and both studies compared the consensual group to a non-consensual group.[9,11] The use of dye in both studies increased the injury detection rates as compared to direct visualization only. The studies that used both dye and colposcopy found similar injury detection rates from 11%[2] to 30%[1] when compared to the studies that used dye only in the consensual group.

In addition to time, age, and tools used to detect injuries, there were also differences in recruitment methods. All of the studies used volunteers, but one study included data from participants who initially reported a sexual assault, but who later recanted.[2] Two of the studies compared results to a non-consensual comparison group with data retrieved through retrospective chart reviews.[1,2] The number of injuries for the non-consensual group were higher than the consensual group. If an injury was present, the non-consensual group was more likely to have two or more injuries compared to the consensual group.[1,2] The posterior fourchette was the most common site of injury with tears being the most common injury type.

Findings from two published studies described how time affected the detection of injuries. In one study, Norvell et al. reported found that 61% of the women had microscopic injuries 6 h after consensual intercourse, compared to 11.1% of the women after 72 h of abstinence.[10] Slaughter, Brown, Crowley, & Peck used a follow up visit (range 4–56 days) to confirm or refute acute injuries.[2] Eighty-seven percent of the injuries found originally resolved at the follow up visit. The study did not report the original rate of injury detection. There were five cases with findings of hypervascularity (redness) which did not resolve by the follow up visit. There are no studies to date investigating changes in injuries during the 72 h following consensual or non-consensual intercourse that explored the possible influence of skin color, reports of pain, reports of roughness, use of a condom, or the use of lubrication.

3. Purpose

The purpose of this study was to collect genital injury (type of injury, genital site of injury, surface area of injury, and number of injuries) data within 48 hours of consensual vaginal intercourse (Time 1) and 24 h later (Time 2). The study methods included: (1) collecting non-identifiable data from a group of women who engaged in consensual intercourse; (2) identifying the differences in injury patterns between two time periods (within 48 h and then 24 h later); and examine the effects of time from intercourse to exam, use of a condom, use of lubrication, vaginal digital contact, self report of pain and roughness.

4. Methods

4.1. Sample

The study was conducted in a rural university based medical center located in the southeastern United States. Prior to commencement of the study, Institutional Review Board (IRB) approval was obtained. Women were recruited through IRB approved advertisements placed throughout the hospital, university, and local community. Women who responded to the flyers by phone or e-mail were invited to come to the university medical center emergency department. Inclusion criteria included women ages 18–40, not pregnant, still having menstrual periods either monthly or regularly on the basis of the type of birth control, no history of a hysterectomy, consensual intercourse (vaginal penile penetration) within 48 h, and sufficient written and verbal English skills to complete the consent process.

4.2. Data collection

Data collected included demographic data (age, race, average number of times sexually active per week); the

number of hours since intercourse; the number of days since last menstrual period; use of a condom; use of lubrication; an estimate of the number of minutes between penile penetration and ejaculation; and reports of pain and roughness assessed with a visual analog scale (0–10). The injury data collection utilized direct visualization, colposcopy, toluidine blue dye, foley catheter to visualize the edges of the hymen, and digital photography to assist in the identification of injuries present. Evidence collection-related questions included whether or not the participant had bathed, urinated, defecated, douched, brushed her teeth, and changed clothing since having intercourse.

4.3. Procedures

After arrival in the emergency department (ED), the study was described to each participant. The participant was given an IRB approved consent form to read and sign if they were interested in participating. Once the consent process was completed, a standardized data sheet was used to collect demographic information and record injuries after both examinations. Participants were asked to abstain from intercourse between exam #1 and exam #2. The tools used to document injuries were developed based on the forms used after a sexual assault.

Genital injury data were identified using the following techniques: visual inspection, colposcopy, digital photography, application of toluidine blue to the external genitalia, and the use of a foley catheter at two time periods. Time 1 was within 48 h of consensual intercourse and Time 2 was within 24 h of Time 1. The injury data included the site of genital injuries, the type of genital injuries, the total number of genital injuries, and the surface area of genital injuries identified during an evidentiary type pelvic examination. Genital injury sites included clitoral hood, cervix, fossa navicularis, hymen, labia majora, labia minora, posterior fourchette, and vaginal walls. Injury types were classified as tears, ecchymosis, abrasions, redness, and swelling. Surface area was measured during the examination and confirmed by recalculating the surface area at each site directly from the digital photographs taken with a scale. Injuries that are irregularly shaped were copied from the photographs using a plastic overlay. The plastic overlay was placed over graph paper with markings every centimeter so the blocks could be counted. The counted blocks were converted into centimeters squared using the measurement from the scale in the photographs to account for actual size of the injury. Surface area calculations were verified by two investigators.

During the genital exam, the women had six standard photograph pairs taken (four of the external genitalia, one of the hymen, and one of the vaginal walls and cervix). Each pair of photos included one with the use of a scale and one without a scale at a magnification factor of 0.4. Prior to the insertion of the speculum, and after the initial photographs were taken, toluidine dye was applied to the external genitalia. Toluidine blue dye stains the nuclei of damaged epithelial cells which helps distinguish acute injuries or breaks in the skin from non-injured areas. To visualize the hymenal tissue and edges, a 14 French foley catheter was inserted vaginally and the catheter balloon was inflated with 10 cc of normal saline. As the catheter balloon was pulled towards the examiner, the hymen was examined using the colposcope and photography with and without the scale. After the catheter was removed, a clear plastic disposable speculum was inserted vaginally to allow for visualization of the vaginal walls, vaginal orifice, and cervix. Any areas of suspected injury were wiped with a sterile cotton swab to confirm injury as opposed to artifact. A final photograph was taken to discern if any speculum-induced trauma occurred. Photographs were destroyed prior to the examination data recorded in the database. The evidentiary type pelvic exam was repeated 24 h later using the same procedure. In order to keep all of the data collected unidentifiable, the data collected were entered into the study chart and database with no references to the date or actual time.

5. Statistical Plan

Statistical package for social sciences (SPSS) version 14 was used for analysis. Frequencies were calculated for all demographic data (continuous and categorical variables) and injury information. Injuries rates were calculated for the number of sites with injury (NoS), the number of injuries (NI), and the surface area (SA) of injuries for both Time 1 and Time 2. The injury classification included: tears, ecchymosis, abrasions, redness, and swelling. The genital sites included clitoral hood, cervix, fossa navicularis, hymen, labia majora, labia minora, posterior fourchette, and vaginal walls (see Table 1). Differences in injuries between time points (Time 1 and Time 2) would be assessed using a non-parametric Wilcoxon signed ranks test, if univariate normalcy was violated for a majority of the variables.

In addition, the variables that may influence injuries (time from intercourse to exam, condom use, use of lubrication, vaginal digital contact, pain, and roughness) were entered into a linear regression to determine if these variables affected the injury rate at Time 1. Univariate and multivariate normalcy were assessed prior to conducting the regression.

6. Results

Five of the women did not return for the second time point assessment. These five women (non-completers) were compared to the 35 women who completed both examinations (completers). Chi square and Mann–Whitney U statistics compared completers to the non-completers based on demographic data, variables that could influence injury rates, and injury rates at Time 1. Categorical data (dye uptake, lubricant use, condom use, vaginal digital contact/penetration, pain, tears, ecchymosis, abrasions, red-

Table 1
Definition of injury classification and ranges

Variable	Definition	Range
Number of sites (NoS)	Total number of sites with an injury of any kind in the following eight sites: clitoral hood, cervix, fossa, hymen, labia majora, labia minora, posterior fourchette, and vaginal walls	0–8
	Subgroups of NoS	
	• NoS with – tears, ecchymosis, abrasions, redness, and swelling	0–8
Number of injures (NI)	Total number of any of the following injuries regardless of the site: tears, ecchymosis, abrasions, redness, and swelling	0–∞
	Subgroups of NI	
	• NI by injury types – tears, ecchymosis, abrasions, redness, and swelling	0–∞
	• NI by locations – clitoral hood, cervix, fossa navicularis, hymen, labia majora, labia minora, posterior fourchette, and vaginal walls	0–∞
Surface area (SA)	Total surface area of any injury in all sites measured in cm^2	0–∞
	Subgroups of SA	
	• SA by injury types – tears, ecchymosis, abrasions, redness, and swelling	0–∞
	• SA by injury location - clitoral hood, cervix, fossa navicularis, hymen, labia majora, labia minora, posterior fourchette, and vaginal walls	0–∞

ness, and swelling) were analyzed using chi square to determine group differences (see Table 2). Continuous data [age, time since intercourse at Time 1, average number of times per week of sexual activity, pain (visual analog scale), roughness (visual analog scale), number of days since last menstrual period, the surface area of all injuries at Time 1, and the number of injuries present at Time 1 were analyzed using non-parametric Mann-Whitney U statistics to compare the two groups (completers vs. non-completers). A non-parametric test was used since the continuous data were skewed. The only significant difference between groups was that visual analog scale for roughness ($p = 0.016$). Non-completers rated the roughness of sexual intercourse experience higher than the completers. Ranges for the roughness scale for both groups were compared and found to be similar (completers 0–6.6, non-completers 1.8–6). Two of the non-completers had roughness scores that were within the mean (1.9) ± one standard deviation (1.9) of the roughness scores for the completers. Based on this analysis, the five non-completers were deemed to be similar in most aspects to the completers, thus the non-completers were excluded from further analysis.

The ages of the women ranged from 18 to 39 with the mean age being 21.1 ± 3.7 years. Seventy-seven percent of the women reported being Caucasian and 23% non-Caucasian (African American 6%, Asian 3%, Pacific Islander 3%, Hispanic 8%, and mixed race 3%). Women reported sexual activity from one to eight times per week (mean 3.3 ± 2.1). Seventy-four percent used birth control pills for pregnancy prevention. All reported vaginal penile penetration with 49% reporting vaginal contact/penetration with a finger, and none of the participants reported vaginal penetration with an object. Sixty percent of the women reported the length of time from penile penetration to withdrawal was greater than 10 min.

The variables that may influence injuries (time from intercourse to exam, condom use, use of lubrication, vagi-

Table 2
Comparisons: demographic and factors influencing injury rates

		Completers ($n = 35$)	Non-completers ($n = 5$)	Statistics	p value
Race	Caucasian	27(77%)	4(80%)	2.1[a]	0.42
	African American	2(6%)	1(20%)		
	Asian	1(3%)	0		
	Pacific Islander	1(3%)	0		
	Hispanic	3(9%)	0		
	Other	1(3%)	0		
Age	Mean ± SD	21.1 ± 3.7	20.2 ± 2.9	−0.9[a]	0.18
Average number of times sexually active per week					
	Mean ± SD	3.3 ± 2.1	3.1 ± 1.7	−0.1[a]	0.47
Number of hours from intercourse to 1st exam					
	Mean ± SD	25.7 ± 14.2	32.4 ± 14.8	−0.9[a]	0.17
Pain scale	Mean SD	0.8 ± 1.4	1.3 ± 2.8	−0.7[a]	0.24
Roughness					
	Mean ± SD	2.3± 1.9	4.3 ± 1.8	−2.1[a]	0.02*
Condom	Yes	11(31%)	1(20%)		
	No	24(69%)	4(80%)	2.7[b]	0.30
Lubrication	Yes	11(69%)	2(60%)		
	No	24(31%)	3(40%)	0.15[b]	0.35
Digital contact	Yes	17(49%)	4(80%)		
	No	18(51%)	1(20%)	1.7[b]	0.09

* $p < 0.05$.
[a] Z from Mann–Whitney U.
[b] χ^2.

nal digital contact, pain, and roughness) were entered into a linear regression to determine if the variables affected injury rates at Time 1 were affected by these variables. Univariate and multivariate normalcy were assessed. Based on the regression, the use of condoms, lubrication, digital penetration, pain and roughness reporting, did not affect the injury rates at Time 1.

6.1. Change in genital injury patterns over time

Differences were found between Time 1 and Time 2 based on total surface area (SA), surface area (SA) of injury to the posterior fourchette, surface area (SA) of injury with abrasions, and surface area of injury with redness. Table 3 includes the results for Wilcoxon signed ranks tests which are based or mean ranks; means and standard deviation scores were included in the table for evaluation of clinical importance of changes in the variables at Time 1 and Time 2. At Time 1, the total surface area (SA) of injury was greater ($p = 0.017$), the surface area (SA) of injury to the posterior fourchette was greater ($p = .015$), the SA of abrasions was greater ($p = 0.037$), and the surface area (SA) of redness ($p = 0.037$) was greater than at Time 2. There were no differences between Time 1 and Time 2 in the number of injuries (NI) or number of sites (NoS) of injury for the following areas: cervix, clitoral hood, fossa, hymen, labia majora, labia minora, perineum, and vaginal walls. There was no difference in the surface area (SA) of injury with tears, ecchymosis, or swelling.

7. Discussion

There were significant differences in genital injuries found between Time 1 and Time 2 in women after consensual intercourse. The differences found were the total surface area of injury, the surface area of injury to the posterior fourchette, the surface area of abrasions, and the surface area of redness. The means of the injuries were greater at Time 1 than Time 2. Even though there are no previous studies comparing injuries at two time points, a prior study found more injuries at six hours after consensual intercourse than after 72 h of abstinence. [10]

Other findings such as use of condoms, lubrication, digital penetration, pain and roughness reported during sexual intercourse, were also assessed in relation to the effect on injury rates. There were no differences noted in the rates of injuries except for the reporting of roughness at time of intercourse. This is an issue that has not been addressed in terms of affecting injury rates in previous studies, only in the occurrence of these events.[1] These findings are important, but preliminary and need further study before use in court.

The sample in this study consisted of women after consensual intercourse. There were several important strengths identified despite the fact that the data collected followed consensual rather than non-consensual intercourse. The finding that genital injuries in women after consensual intercourse were less at the second examination (24 h after the first examination) was helpful in identifying changes in injury patterns as time increases.

Because there is no prior research addressing changes in genital injuries over time or the importance of the surface area of injuries, the findings of this study are a significant beginning in filling this gap in the research. It has been well documented that genital injuries heal quickly, but how these injuries changed during the 72 hours after consensual intercourse highlight the importance of the time from sexual assault to examination, especially since this information is used in courtroom proceedings.

Several limitations were identified. There was the lack of a comparison group (sexually assaulted women) examined at two different time points during the 72 h after being sexually assaulted. The importance of knowing how injuries change over time specifically in the sexual assault group is essential. During this study, the women who were sexually assaulted were offered the opportunity to participate

Table 3
Injuries with significant differences over time

Surface area (SA)	Mean	SD	Mean ranks		Wilcoxon sign	*p* value
			Negative	Positive	Rank Z	
SA total						
Time 1	1.78	3.33				
Time 2	1.05	2.93	13.23	8.56	−2.114	0.017*
SA posterior fourchette						
Time 1	1.18	2.55				
Time 2	0.73	2.76	10.38	7.20	−2.156	0.015
SA abrasions						
Time 1	0.79	2.78				
Time 2	0.41	1.47	5.88	6.50	−1.789	0.037*
SA redness						
Time 1	0.94	1.91				
Time 2	0.57	1.73	7.10	6.67	−1.784	0.037*

* $p < 0.05$.

in the study by returning for the second examination 24 hours later. For a variety of reasons, most choose not to participate. The reasons given were: stress related to the assault; needing to meet with law enforcement after the first exam; difficulty with the consent form; and not wanting a second evidentiary pelvic exam. Being sexually assaulted is very stressful and many of the women reported the stress when approached about the study. Another reason given for not participating in the study was the time involved. After the evidentiary examination was complete, the victim would still need to meet with law enforcement to finish the forensic interview, and sometimes they would be taken back to the crime scene to make sure no details were excluded. This left little time to rest prior to returning to the ED. During the evidentiary examination, victims were asked to read and sign other consent forms (admission to the ED; evidence collection; photography; emergency contraception; and HIV testing) before the study consent for this study. Another reason for not participating that was given was some of the victims found that after being sexually assaulted, the first pelvic examination, was traumatic, and believed that a second pelvic examination may be overwhelming.

Other limitations include the small sample size ($n = 40$) which was further reduces when five participants who did not complete the second examination, decreasing the sample to 35 women. The small sample size may have limited the ability to identify statistical differences in changes over time in the number of genital injury sites and the number of injury types, and the surface area of injury.

This exploratory study addressed some of the differences in genital injuries in women over time following consensual intercourse. This information is crucial to legal proceedings when addressing the injuries following sexual assault represents. Recent challenges to expert testimony regarding the human sexual response and injuries following sexual assault have brought to light a lack of scientific evidence supporting the relationship of genital injury to lack of consent, use of force, and vaginal penetration in sexual assault proceedings. Gaffney noted, "... associations, correlations, or causal explanations cannot be made without the scientific evidence that established these relationships".[13] Yet, to date only one study began to explore genital injuries in relation to skin color[14] and there are no studies to date investigating genital injuries changes over time during the 72 h following a sexual assault or consensual intercourse.

Larger studies are essential to validate these findings, especially since this research was exploratory, with a small sample and a lack of a non-consensual group. Future research is needed to address changes in injuries over time and the influence of skin color in women who were sexually assaulted women and to determine how these patterns differ from women who had consensual intercourse. It will be essential to identify a way to recruit sexually assaulted women for repeat examinations without causing more distress. It will be important to develop a tool to assess skin tone in order to further investigate variations within light and dark skin women. In addition, a method of placing a weight or impact score to each injury type based on the depth of injury and area affected needs to be developed.

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